

Global Sustainability: Water-Food-Energy Nexus



Membrane Technology for Global Sustainability



Advances in Membrane Technology

New Membrane Development



ANDREN

Catalytic membrane

Graphene membrane





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Nanoparticles embedded membrane



New Membrane Process

(1) Hybrid Membrane Processes = Membrane filtration + XX=Coagulation, Adsorption, Catalysis, Biodegradation

(2) Environmental friendly new membrane process: Low fossil fuel consumption, less CO2 production, less waste discharge (zero-discharge process)

(3) Customer friendly new membrane process: Excellent performance, easy maintenance, low capital cost, easy retrofitting

Membrane Technology for Water and Wastewater Treatment <u>An example: Singapore case</u>



Sources: Nature, September 2010

ACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING □ Singapore has little land to collect and store rainwater.

□ Climate change influences rainwater frequency and intensity.

□ The water demand due to increasing population, living standards, urbanization, and high-tech industries increases.

As not enough fresh water to meet the demand, Singapore faces the problem of water constraint!

Membrane Technology for Water and Wastewater Treatment

Johor River □ Importing 250 mgd from Johor River Transmission & distribution network (Malaysia) till 2061 (5,400 km) To 1.3 million 8 PUB 14 service premises directly water treatmen reservoirs er through high plants 2/3 of Singapore's land area for water level tanks **17** reservoirs catchment (underground pipelines and green roof) catchme 17 reservoirs for rainwater storage Used water network (3,400 km □ Three desalination plants (130 mgd) 2 desalination of sewers plants and DTSS¹) le sali na le c □ Two desalination plants in construction 77 pumping Installations Transmission □ Purifying treated used water using network **4 NEWate** advanced membrane technologies (515 km) factories 5 service 450 accounts reservoirs □ For industrial use and topping up reservoirs. 4 water reclamation plants **JNIVERSITY OF ICELAND** Saa FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

Membrane Technology for Water and Wastewater Treatment





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Membrane Technology for Seawater Desalination

Membrane Technology for Surface Water Treatment



- > More flexible
- Large footprint
- More chemical usage





- Less footprint
- Less chemical usage
- Less sludge production
- Superior water quality
- > High energy consumption

Membrane Technology for Municipal Wastewater Treatment

Conventional Wastewater Treatment Process



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Membrane Technology for Wastewater Reclamation (NEWater)



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Membrane Technology for Decentralized Wastewater Treatment





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Membrane Technology for Food Industry

An example: Food product decoloring



Membrane Technology for Food Industry

An example: Whey protein concentrating



Membrane Technology for Food Industry

An example: Algal harvesting



Membrane Technology for Pharmaceutical Industry

(1) Membrane techniques for down-stream pharmaceutical product separation, purification, concentration, percrystallization;

(2) Membrane techniques for solvent recovery from mixture containing temperature sensitive products or reagents that can raise some process safety concerns using conventional distillation;

(3) Membrane techniques for catalyst recovery;

(4) Membrane techniques for pharmaceutical wastewater treatment.





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